DOCUMENT RESUME

ED 061 307 TM 001 475

TITLE	Coil Assembler 6-94.515; Unit Assembler 8-93.41; Unit Assembler 8-94.51 -- Technical Report on Standardization of the General Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	TR-S-102
PUB DATE	May 57
NOTE	10p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Air Conditioning Equipment; *Aptitude Tests; *Assembly (Manufacturing); *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; Norms; Occupational Guidance; *Personnel Evaluation; Test Reliability; Test Validity
IDENTIFIERS	Coil Assembler, Unit Assembler; GATB; *General Aptitude Test Battery

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

ED 061307

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

COIL ASSEMBLER 6-94.515
UNIT ASSEMBLER 8-93.41
UNIT ASSEMBLER 8-94.51

B-358 or S-102

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TM 001 475

U. S. Employment Service in
Cooperation with
Mississippi State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
May 1957

GATB #2126
Winter 1956

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR COIL ASSEMBLER 6-94.515 UNIT ASSEMBLER 8-93.41 UNIT ASSEMBLER 8-94.51

B-358 or S-102

Summary

The General Aptitude Test Battery B-1002A, was administered for a longitudinal design test development study to the male applicants who were to be referred to McQuay, Incorporated, Grenada, Mississippi for consideration for employment as Coil Assemblers and Unit Assemblers. The final sample of employed assemblers consisted of 61 men. The criterion consisted of supervisory ratings expressed in broad categories. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes G-Intelligence and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51 - B-358 or S-102

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-358 or S-102

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	90	G	Part 3 Part 4 Part 6	85
M	CB-1-M CB-1-N	75	M	Part 9 Part 10	75

Effectiveness of Norms

The data in Table IV indicate that 12 of the 20 poor workers, or 60 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 60 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 32 of the 40 workers who made qualifying test scores, or 80 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupations of Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51.

II. Sample

During the period of November 1954 to November 1955, the GATB, B-1002A was administered for a longitudinal design test development study to 148 male applicants for employment at McQuay, Incorporated, Grenada, Mississippi. Those people selected for referral were given the GATB and referred to the employer for consideration without regard to test results. This process continued until a total of 75 tested men were employed and had reached such proficiency that they could be given a rating by the employer. Fourteen of the tested sample of 75 men were not included in the final sample which consisted of 61 men. Eight men were dropped from the sample because they were on other jobs in the plant and six were dropped because they had not been employed long enough to reach full proficiency on the job.

The company considers two months as the time required for a person to learn the duties of these jobs and to reach full proficiency. The general age range for hiring is 19 to 45 years, with people from 21 to 40 preferred. Three people in the sample were under 21 years of age and three were over 40 years old, including one person who was 51 years of age. The company set a minimum hiring requirement of an eighth grade education. However, one person in the sample with only a seventh grade education was employed. Workers who have completed high school are preferred. Credit ratings, character references and references from former employers are carefully considered by the employer. Each applicant was carefully interviewed. Each interview was thoroughly conducted and was of sufficient length to give the interviewer substantial reasons for hiring or rejecting an applicant. A large number of those not hired were rejected as a result of this interview.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, and Pearson Product Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for Age, Education and Experience

Coil Assembler 6-94.515
Unit Assembler 8-93.41
Unit Assembler 8-94.51

N = 61

	M	σ	Range	$_{c}r$
Age (years)	28.8	6.7	19-51	-.150
Education (years)	11.1	1.6	7-15	.058
Experience (months)	6.5	4.5	2-16	.456**

** Significant at the .01 level

The correlations between the criterion and age and education are not significant. However, the correlation of .456 between experience and the criterion is significant at the .01 level. This indicates that those workers who had been on the job longer were better workers and/or that the supervisors who made the ratings were biased in favor of the workers with greater experience. The criterion was not corrected to nullify the influence of experience because the ratings were expressed in broad categories and the statistical correction technique used for this purpose was not applicable.

III. Job Descriptions

Job Titles: Coil Assembler 6-94.515
Unit Assembler 8-93.41
Unit Assembler 8-94.51

COIL ASSEMBLER

Job Summary: Assembles coils for air-conditioning or heating equipment by performing any one or more of the following tasks: cuts copper tubing to required length; burrs ends of copper tubes; operates tube bender to bend copper tubes as required; assembles coil; tests coil and tags completed coil.

Work Performed: Cuts copper tubing to required length: examines work order; obtains tubing of the correct diameter, places one or more pieces of tubing on table and sets stop to required length; operates power saw to cut the tubing; places tubes in racks according to length and diameter of tubes and throws scrap in box for salvaging.

Burrs end of copper tubes: places the copper tube against a buffing machine to smooth the end of tube and to taper it slightly at the end.

Operates a tube bender to bend copper tubes when required: studies work order and sets bender for proper size of tube and angle to which the tube is to be bent (most tubes that are bent are bent into the form of a "u"); manually operates the bender to bend the tube to the required shape.

Begins assembly of coil: sets jig according to size of coil (coils vary in size from approximately 12" by 8" by 4" to 20' by 5' by 3'); obtains fins from nearby racks and stacks them in vertical position in jig (fins are thin strips

of aluminum in which a number of holes have been punched; they vary in size from approximately 8" by 4" to 5' by 3'; the fins are not counted, but enough are placed in the jig to cause all of the fins to stand in an upright position). Inserts two metal rods of appropriate size through holes in the fins to give some rigidity to them. Inserts copper tubes through holes in the fin until all holes have been filled; removes the metal rods and inserts tubes through those holes. If tubes which have previously been bent into a "u" shape are used, places them in accordance with diagram furnished with work order. Expands tubes (working alone or with another worker, depending upon the size of coil being assembled); holds metal cap on one end of tube and places hose nozzle over the other end. Forces water through tube to expand it (when working with another worker, one holds the cap while the other uses the hose); continues until all tubes in coil have been expanded. (This expansion results in the coil having complete rigidity.) Places "u's" over ends of two tubes ("u's" are pieces of copper tubing of proper diameter bent into the shape of a "u"); follows diagram in placing the "u's"; continues until "u's" have been placed on ends of all tubes except the ones designated as "inlet" and "outlet." Passes coil to Brazer for brazing.

Tests completed coil after brazing has been completed; closes outlet and attaches hose to inlet; submerges coil into water. (For smaller units, places coil in cradle, either doing it alone or with the aid of another worker, and lowers it into water. For larger units, uses hoisting equipment to raise the coil and place it in water.) Forces compressed air through the coil and watches for leaks as revealed by bubbles in the water; if leaks are found, raises the coil and either brazes the leaks himself or returns the coil to the Brazer.

Tags completed coil, which is then carried to Unit Assembly Department.

UNIT ASSEMBLER 8-93.41
UNIT ASSEMBLER 8-94.51

Job Summary: Completes the assembling of air-conditioning or heating equipment units by performing the following duties: places coils in metal case; attaches connection for water or steam pipes; attaches motors and fans or blowers, and completes assembly of case using screws and bolts and hand or power-driven tools.

Work Performed: Places coil on blocks on bottom of case (if coil is large, is assisted by another worker or uses hoisting equipment).

Attaches sides and ends of case to the bottom of the case, using screws or bolts and hand or power-driven tools.

Attaches connections for water or steam pipes to coil, passing them through holes in the case, using wrenches to tighten the pipes.

Attaches electric motors and fans or blowers to case, using screws or bolts and hand or power-driven tools.

Attaches top to case, using screws or bolts and hand or power-driven tools.

Tags completed unit and sends it to crating department for shipping.

IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion data were collected when all of the workers in the sample had at least two months of experience. The criterion consisted of supervisory ratings prepared by three supervisors. Each of the supervisors rated the workers under him and the plant manager reviewed these ratings and made slight adjustments in them for the final ratings. Each worker was placed in one of three broad categories: the A (above average) group with 19 workers, the B (average) group with 22 workers and the C (below average) group with 20 workers. For statistical purposes the broad category ratings of A, B and C were converted to quantitative scores of 61, 50 and 39, respectively.

VI. Statistical and Qualitative Analysis

Table III shows the means, standard deviations, Pearson product-moment correlations (corrected for broad categories) with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for the Aptitudes of the GATB

Coil Assembler 6-94.515
Unit Assembler 8-93.41
Unit Assembler 8-94.51

N = 61

Aptitudes	M	σ	$_{c}r$
G-Intelligence	92.0	10.8	.353**
V-Verbal Aptitude	87.7	10.3	.038
N-Numerical Aptitude	93.5	13.8	.296*
S-Spatial Aptitude	91.3	17.2	.291*
P-Form Perception	90.7	14.5	.219
Q-Clerical Perception	91.9	13.5	.029
K-Motor Coordination	91.9	12.9	.265*
F-Finger Dexterity	89.8	12.0	.176
M-Manual Dexterity	92.4	15.7	.081

** Significant at the .01 level
* Significant at the .05 level

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Intelligence (G) - required to read and interpret blueprints and work orders, and to determine the order in which work should be completed.

Numerical Aptitude (N) - required in taking measurements and making simple calculations.

Motor Coordination (K), Finger Dexterity (F) and Manual Dexterity (M) - required in using various hand tools, inserting copper tubes, placing "u's" on tubes, attaching motors and fans to coils and in completing assembly of units.

The highest mean scores in descending order of magnitude were obtained for Aptitudes N, M and G, respectively. All of the aptitudes have standard deviations of less than 20. Aptitudes V and G have the lowest standard deviations.

For a sample of 61 cases, correlations of .328 and .252 are significant at the .01 level and the .05 level of confidence, respectively. Aptitude G correlates significantly with the criterion at the .01 level. Aptitudes N, S and K correlate significantly with the criterion at the .05 level.

Consideration was given to Aptitudes G, N, S, K, F and M for inclusion in test norms on the basis of the following quantitative and qualitative factors: Aptitudes G, N, K, F and M appeared to be of some importance on the basis of job analysis data; Aptitudes G, N and M had the highest mean scores and Aptitude G had a relatively low standard deivation; Aptitudes G, N, S and K showed significant correlations with the criterion. Tetrachoric correlations with the criterion were computed for several sets of trial norms consisting of various combinations of Aptitudes G, N, S, K, F and M with appropriate cutting scores. However, the addition of any of Aptitudes N, S, K or F, either individually or in any combination, tended to lower the selective efficiency of norms which included Aptitudes G and M. Therefore, Aptitudes N, S, K and F were excluded from the final test norms, which include Aptitudes G and M.

The cutting score for Aptitude G was set at one standard deviation unit below the mean of the experimental sample and rounded to the higher adjacent five-point score level, and the cutting score for Aptitude M was set at one standard deviation below the mean rounded to the nearest five-point score level. Setting cutting scores at these levels yielded the best selective efficiency for the norms and resulted in critical scores of 85 and 75 for Aptitudes G and M, respectively.

VII. Predictive Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized with those workers rated as "A" and "B" placed in the high criterion group, and with those rated as "C" placed in the low criterion group. This resulted in 20 of the 61 workers, or 33 percent of the sample, being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes G and M with critical scores of 85 and 75, respectively, and the dichotomized criterion for Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes G and M with Critical Scores of 85 and 75, Respectively, and the Criterion for Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51.

N = 61

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	9	32	41
Poor Workers	12	8	20
Total	21	40	61

$r_{tet} = .58$ $\qquad$ $X^2 = 7.018$

$\sigma_{r_{tet}} = .21$ $\qquad$ $P/2 < .005$

The data in the above table indicate a high and significant relationship between the test norms and the criterion for this sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes G and M with minimum scores of 85 and 75, respectively, are recommended as B-1002 norms for the occupations of Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51. The equivalent B-1001 norms consist of G-90 and M-75.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include two aptitudes, only those occupational aptitude patterns which include the same two aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. Four of the existing 22 occupational aptitude patterns meet these criteria for this study. These occupational aptitude patterns and their B-1002 norms are as follows: OAP-8, G-95, S-95, M-85; OAP-10, G-75, F-75, M-80; OAP-19, G-80, N-75, M-85; and OAP-21, G-80, K-90, M-80. The selective efficiency of each of these OAP's for this sample was determined by means of the tetrachoric correlation technique. No significant relationships were obtained between any of the four OAP's and the dichotomized criterion. Therefore, none of the existing 22 occupational aptitude patterns is recommended for the occupations of Coil Assembler 6-94.515, Unit Assembler 8-93.41 and Unit Assembler 8-94.51. However, the data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.